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FOREWORD.

The complete works of Swami Rama Tirtha have been published in the four volumes of "In Woods of God-Realization," the fourth of which contains the article on Mathematics presented in this tract. This was the very first article written by Rama and specially for the Student Community

The fourth volume having run short yet awaits republication, but in the meanwhile, for the benefit of the students specially, this article on Mathematics has been taken out of it and published by itself at a nominal price. Further, to enhance its value and to make it more attractive and useful a photo of Swami Rama as a professor, along with his life-sketch with fuller details of his student life is also given. The life-sketch has been rather hastily written to meet an urgent demand for the article but it is presented in an arranged form, specially bringing out those points in Rama's unique life as may serve to inspire and guide many a poor student labouring under sore difficulties and may make his life's burden light and cheerfully borne.

The sketch is based mostly on the materials contained in Shri R. S. Narayana Swami's Urdu

edition of Swami Rama's life and the life and appreciation of Rama in English by Mr. Puran, from which several quotations have been taken.

If this small tract is appreciated and received warmly and eagerly by the public, as it should it will encourage the Publishers to issue a series of such handy booklets containing the most useful articles of Swami Rama and other saints and savants

Any suggestions for the improvement of the series will be thankfully received.



SWAMI RAMA TIRTHA.



PROF. TIRTHA RAM GOSWAMI M A

(1896.)

A BRIEF LIFE SKETCH
OF
Swami Rama Tirtha.

(*Specially Written*).

Swami Rama, previously known as Gosain Tirtha Rama, M A, was born on Wednesday, the 22nd October, 1873, on the day following the Diwali at Muraliwala a small village in the District of Gujranwala, Punjab Born in the family of Gosain Brahmans, he was the direct descendant of Gosain Tulsi Das the famous author of the Hindi Ramayana and in the line of Rishi Vasishtha, the Guru of Bhagwan Sri Rama Chandra.

Birth and Family.

His father Gosain Hirananda had no means of livelihood except what he received as gifts in his spiritual tours to Peshawar and Swat, His mother passed away when he was but a few days old, and he was brought up by his elder brother Gosain Guru Das and his old aunt. Swami Rama was thus born under the lowly roof of a poor but noble Brahman family.

He was brought up on cow's milk and remained very weak and thin during his childhood. His aunt, who was a model of goodness, chastity and devotion, used to take the little

Childhood and predictions.

Rama along with her to temples and shrines where the worship offered, the recitations from the Puranas, the Mahabharat and the Bhagwat, and the blowing of the conches had a strange fascination and charm for him. So much so that he used to cry if he heard the conches blow in the neighbourhood, and no toys, no sweets, nothing indeed satisfied the baby short of its being taken to the place of worship

As a child he was very attentive in listening to the recitations of the sacred lore and would rather forego his meals or even the much-loved studies than not go to attend the 'Kathas'

He ruminated over the stories he had heard with a precocious mind, put questions and offered appropriate explanations. His village people bear testimony to his unusual intelligence, his contemplative nature and his love of solitude.

Thus the devotional songs and stories and the sacred sound of the conches had early impressed the baby mind and sown the seeds of a intense longing for the Divine.

Quite an uncommon child, it was predicted by astrologers that he was the coming genius of his race, the illuminator of faith, a traveller

of foreign lands, and had danger of life by water in his 33rd year. This prediction came true literally.

3. Early Marriage.

While he was yet a baby, only two years old Rama was betrothed by his father to the infant daughter of Pandit Rama Chandra of Viroki in the Tehsil Wazirabad of District Gujranwala, and was married in his tenth year. It can only be imagined how this early marriage stood in the way of Rama's studies later on but at the time he was too young to make any protests. It points forcibly to one of the evil customs of our Hindu Society which not a few still follow in their ignorance and only succeed in putting a double burden of a student and household life on the shoulders of their younger generations stunting their growth, undermining their health and intellect, and ruining their lives for good.

It was through sheer strength of determination and devotion and love for studies that Rama successfully met and overcame every obstacle put in his way.

4. Student Life.

He became a student at the age of five. He was admitted into a Vernacular Primary School in the village Muraliwala

(i) Primary Education.

Though tiny in size and simple in habits, he had a splendid memory and was both intelligent and industrious. The Head Maulvi of the school was at times quite astonished at his intelligence and memory. At this early age in his 5th class, he had finished Gulistan and Bostan (the two standard Persian books) besides the school books and had committed to memory a large number of Urdu poems.

But he was not given to sports and games at all. The whole day was spent in study and in the evening as soon as he got leizure he used to go to Dharamshalla to hear the much loved recitations of the sacred books. On his return he took his evening meals and recited before his admiring relations each and every word of what he had heard without any additions or alterations whatever.

(ii) Secondary Education and Guru.

After finishing the primary education he went with his father to the High School in Gujranwala, a distance of about 7 miles from his village. Being only ten years old he was there left by his father under the protection of his able and kind friend Bhagat Dhanna Ramji, who was consequently regarded by Rama and accepted in true faith and devotion as his Guru or Spiritual Guide.

He was admitted there in the special class to study English and after coming out successful was taken into the Middle class in 1886. He was now 12 years old and cherished an intense devotion towards his Guru whom he wrote his first letter in Urdu from Viroki (his father in-law's place). In the course of his secondary and college education he exchanged more than a thousand letters with his Guru, many of which have been collected and printed in Urdu in the form of a book called Rama Patra They are highly interesting to read and show the great depth of devotion and faith and respectful attitude which he always had for his Guru though illiterate.

(iii) University Education.

(a) Entrance.

In 1888 when fourteen and half years old, he passed his Entrance Examination from the Punjab University, standing first in his school and 38th in the University and gained a scholarship. But his father did not want him to read further and so he came to Lahore for admission into College quite against his father's will. Consequently, he had to subsist on the small sum of scholarship that he had secured from the Municipal Committee, Gujranwala on account of his first position in the school

already mentioned and was admitted in the Mission College, *Lahore* In his second year specially he worked so hard that he was very often ill. It was not unoften that he kept himself absorbed in his studies from sunset to sunrise. Solitude, hard work, and ample time for his studies were what he loved dearly.

(b) F. A.

As a result he stood first in F. A. in 1890 and also secured the Government scholarship notwithstanding his continued illness and the fact that he had taken Sanskrit in F. A., as against Persian which he had studied up to Entrance.

(c) Trials and difficulties in B. A.

He continued his studies in the B A., class in the same Mission College with perfect faith in God and his Guru and maintaining life on the scholarship he secured But when his father saw that he could maintain himself without his help and was not willing to undertake any service according to his wishes, he felt very angry and took Rama's wife with him to Lahore and left her also in charge of poor Rama for a year or so without any kind of support from himself. Gosain Rama had now to face a number of difficulties, *viz.*, the house rent, the cost of books, the college fee, the expenses for his wife and himself etc , etc. But such were

his undaunted courage to meet any difficulties and the supreme love of knowledge for its own sake that he could entirely forget the ordinary comforts and physical needs of daily life.

He would forego an extra suit, an extra loaf or even a day's meal for the oil of his midnight lamp and would actually starve for days together without however, showing the least signs of suffering or sorrow on his face for he attended College regularly with a calm and peaceful appearance and kept to his studies as usual

(d) An incident.

Once Gosain Rama happened to spend his scholarship in the purchase of his text books and did not care at the time to make provision for other expenses. As a consequence he found out that what he had left was only a very trifling sum which could be spent during the month at the rate of only 3 pices or 9 pies per day. He was at first rather at a loss what to do but a moment after said to himself that God wanted to test him, that at least beggars did pass their days on two or three pices a day and hence he should not fail under that trial Rama, therefore, began to subsist on two pices worth of bread in the morning and only one pice in the evening. But soon after, one

evening the shop keeper accosted him with the remarks that he took pulse free along with one pice of bread ; that such a business could bring him no profit and hence he could no more sell one pice worth of bread to him Thereupon Rama resolved to partake of food only once a day until he got money again.

(e) Character as a student.

Thus with an iron will did he fight his way coolly like a soldier day and night and win over field after field of knowledge. Hunger and thirst cold and heat, could not tell upon this supreme passion that he felt towards knowledge. He was a typical student who loved to study not with any hope of gaining worldly ends, but for satisfying the evergrowing thirst for knowledge which was firing his soul anew with every new sun His daily studies were sanctified oblations on the altar of this '*havan kund*" He was the patient architect of himself from childhood to manhood. He built himself little by little, moment by moment and day by day. It may be said that perhaps the whole career of his further life was sketched already before his mind's eye, because even as a boy he was working so gravely, so silently and so consciously for a definite mission. He had an angelic nature with a purity and innocence of life rarely met with.

As a student he lived in extreme poverty.

(f) Dress.

The dress of the boy Rama consisted of a shirt, a pair of Punjabee trousers and a small turban, each made of a cheap and very coarse country cloth, the entire outfit costing about Rs 3. He always wore native shoes even while studying in B. A., class and was rather in a fix what to do when he had to use the prescribed pair of boots in the Convocation Hall. Once he lost one of his shoes in a drain while it was raining and the next day he went to college with the remaining shoe in one foot and an old used shoe of a female in the other. Afterwards he purchased a new pair for nine annas and three pies only.

(g) Physical appearance.

He had a soft handsome face of a typical Aryan cut. The eyebrows arched over a pair of spectacles covering deep black eyes, which showed the mysteries and love of his soul. In contrast with a big, broad, prominent forehead, showing high intellectual power there was feminine softness round his lips. When he was serious the lower lip pressed against the upper on a small round chin, which betokened indomitable strength of will. But he was bashful like a modest girl. Living as he did in the light of love, he looked transparently pure through his small, frail, fair-coloured body. And yet, under this unassuming humble appear-

ance there lay hid a remarkable man with some lofty aspirations and noble aims, which the Brahman body thought too sacred to be uttered.

(h) Greater Trials.

Now to return to our narrative of his studies in the B. A, class, we find still greater trials awaiting for Gosain Rama. In the year in which he appeared for his B. A. examination there was such a confusion in the examination of English papers that some of the best boys failed to pass while the one who came out first was the boy whom the Principal was not going to send up at all. Poor Rama was also one of those who failed and he failed by only three marks in English although he was first in the whole University in the aggregate of marks.

(i) New Rule passed.

There was a great agitation and discussion in the papers which resulted in the passing of a new rule in the University, though nothing could be done for Rama. It came into force from the next year and provided for the re-examination of the answer-books of a body who failed by only five marks. Rama had, therefore, to accept his hard lot, and to continue his studies in B. A., for one year more. That very year a state scholarship was awarded for the study of Mathematics in England

to a candidate who was not over 21 years and had passed his B A., or M.A., in Mathematics. This was eligible for Rama but as he failed in B. A., he could no longer get it.

Again, the scholarship, which he was hitherto getting, was also stopped owing to his failure in B A. This was a moment of sore trial for him and although he saw only gloominess all around yet his trust in God never forsook him and his courage never failed him.

(j) Resolution and Self-Surrender.

He resolved all the more firmly to pass his B.A, examination and with tears in his eyes he prayed to God in solitude making a total self-surrrender of himself. From the depths of his grieved heart came forth the well-known couplet:—

त्वमेव माता च पिता त्वमेव । त्वमेव बन्धु श्च सखा त्वमेव ॥
त्वमेव विद्या द्रविणं त्वमेव । त्वमेव सर्वं मम देवदेव ॥

Thou alone art my mother and father,
Thou alone my relation and friend.
Thou art knowledge, Thou art wealth,
Thou art all, my God of gods !

(k) Unexpected help.

The next day, when he got himself admitted in B. A., again, he found to his great surprise that the College sweetseller L. Jhandu Mall came full of sympathy and requested him to dine thereafter daily at his house. Rama, of course, accepted

the timely offer and invitation. This generous sweetseller not only helped him with food but provided him with clothes also from time to time and also a free house to live in. In times of great need he was helped with money and food by one of his relatives also namely P. Raghunath Mal, Assistant Surgeon who was also his teacher for some time Not only this but the Principal called him and handed over a sum of Rs. 53 only saying that it was given to him for Rama by somebody. He hesitated to accept the whole sum but only half of it and entreated the Principal to spend the other half for some College purpose, or, to pay to Mr. Gilbertson the Professor of Mathematics, who had been very generously paying up half of his College fee. But the Principal pressed him to accept it and he had to do so. Moreover, he undertook some private tuitions also, even giving free instructions to some in his hard pressed time, for he took a great delight in teaching. Thus he toiled on till the time was ripe to send the University fee of Rs. 30 only. God helps those who help themselves. Just when he was thinking about it and how to meet the difficulty, Mr. Gilbertson, who was extremely pleased with Rama's industry and intelligence called him apart and gave him something wrapped in a piece of paper. On going home he opened the little

packet and found to his surprise the exact sum of Rs. 30 only.

(l) B. A. Test.

In his test examination, he stood first gaining 60 marks more than were required for First Division. In Mathematics he gained 145 marks out of 150. He had so much self-confidence when he appeared in his B A. examination that in his Mathematics paper while he had a choice of doing any 9 questions out of 13, he solved all of them and requested the examiner to select any nine, although the paper was a stiff one and other boys were able to do 3 or 4 questions only at their best.

(m) B. A. Result.

In 1893, his success was a marked one, for he stood First in the Punjab University in B. A. and in First Division, securing 310 marks. He also gained two scholarships, amounting to Rs. 60 per month besides a gold medal, a gown, and other rewards. All this was the result of his perfect trust in God and firm determination.

(n) M. A. Study.

He was now nineteen and a half years old when he entered for his M. A. in Mathematics in the Government College, Lahore, as there was then no M A. in the Mission College. He used to teach his class-fellows with so much pleasure that he used to leave off

his own work at once, however busily engaged, if any of them asked him a question. While studying for his M. A., he also acted as an honorary professor of Mathematics in the Forman Christian College, where he had himself studied, and worked for about two years thinking it to be his duty to discharge the debt he owed to his Alma Mater. He used to study at least four or five books on the same subject He was the idol of all his teachers who were always very kind to him. When he passed his B. A., with distinction he had a chance to accept the State-scholarship for Civil Service but he only liked to be a teacher or preacher.

(o) Daily routine in M. A.

In one of his letters to his Guru, dated the 9th February 1894, he writes about his daily routine as follows :—

"I rise from bed at about 5 A. M. and study till 7 A. M, then go to answer the call of nature, take my daily bath and exercise. After that I go to Panditji (reading in the way). Thereafter an hour I take my food and go to college along with him in a conveyance. On return from college I take milk in the way and after a few minutes stay at home I proceed towards the river Rávi where I take a walk for about half an hour by its side. On my return I make a round of the city through its gardens and reaching home again walk up and down

the roof of the upper storey of the house until it becomes dark. But you should not forget that I walk up and down never without studying from a book at the same time. On dusk I take my exercise and after it read till 7 p. m. Then I go to take my meals and to teach Prem, a student. On return I take exercise again and then study till about half past ten in the night and lastly go to bed. It is my experience that it is only when our stomach is in a healthy condition that we feel cheerful and buoyant, concentrated and keen in intellect and memory, and can offer our prayers to Him with a pure heart. I, for one, partake of food very sparingly and what I do eat I make it a point to digest it thoroughly."

(p Food and Exercise.

It may be remembered that being very studious, Rama was, in his student life even up to B. A. very weak in health often suffering from fever, headache and constipation of which he wrote to his Guru in some of his letters. But now he realized the value of open air exercise and light but nourishing food well digested. In his M A, in 1894, he took delight in taking pure milk so much that he wholly subsisted on it and took long walks, often of 30 miles without feeling tired. On the contrary he felt very healthy, light and clear in brain. He invented new and odd exercises but very effective at the same time.

One of them was to raise and lower slowly a bedstead (cháipái) which he could do 160 times and which the strongest of the College boys could not do more than 20 times. He never used an umbrella even in the hottest sun or the rainiest day.

(g) M. A. Result.

In 1895, when Rama was about 20 years old, he obtained his M. A., degree in Mathematics with a very high percentage of marks, although the Mathematics papers that year were specially hard, the like of which (as Rama himself says) were never before set in any Indian University in M. A.

'Mr. W. Bell, then Principal of the Government College Lahore, thought very highly of his exceptional attainments and wished him to go up for the competitive Examination of the Provincial Civil Service. But Gosain Rama's own desire was to teach Mathematics which he had acquired with an infinite amount of labour. He thought in those days of taking the State Scholarship—as it was his right that year and going to Cambridge for the Blue Ribbon. But he was destined to be a greater man in another line than a mere Senior Wrangler, and the scholarship was given to a young Mohamedan'.

5 Service and Public work.

For sometime, after his M. A, in 1895, he opened Private Classes in Mathematics for F. A., and B. A., stu-

dents on Rs. 10 and Rs. 15 each, per month, respectively and besides these students one or two professors of the Colleges also came to study with him. All this was a very hard work and told upon his health. So he had to return to his home Muraniwala in Gujranwala. After regaining health a few months after he came back to Lahore and became a member and later on the Secretary of the Education Committee of Sanatan Dharma Sabaa. In the meanwhile he learnt the art of Drawing in the Vedic College, Lahore.

(i. Sialkote.

Then near the end of 1895, he became the Second Master of American Mission High School, Sialkote, on Rs 80 p. m. and in a few days he became known among the boys as one who could multiply by memory sums reaching to millions. Many a boy from distant places flocked in his school and he was on such familiar terms with them that whatever they asked for he gave them without hesitation. Any boy could according to his need go and drink milk from the sweets seller on Rama's account. Thus he spent the whole of his pay on students and passed a simple life among them full of mercy, sympathy and unselfishness. He also took part in the local Sanatan Dharma Sabha and other religious bodies giving his inspiring lectures as at Lahore.

In 1896, he also became the Superintendent of the Mission Boarding House, Sialkote, but only after a month or two, in the same year he got an appointment as Professor of Mathematics in the Forman Christian College, Lahore.

(ii) Lahore.

He also acted as Reader for a short time in the Oriental College, Lahore. Whatever he got as his pay of professorship he used to distribute almost the whole of it at once among the deserving persons and thus left for himself a very scanty and trifling sum month by month. He cared not for his own physical self and its comforts, nor for wealth, or clothes, or material needs, but was being gradually transformed and coloured inwardly with true mental renunciation (Vairágya).

6. Devotion to Krishna.

He had an intense love for Bhagwad Gita and read and re-read it time after time till he had dived deep into its inner meanings and made himself one with it. His devotion to Shri Krishna developed to such an intensity that many a night found him weeping constantly in his separation so much so that his bed sheets were found all wet in the morning. He would go to the Ravi side and remain absorbed in meditation till late in the night. All his holidays were spent in constant thought of his beloved Krishna and if

he lectured in Sanatan Dharma Sabha on 'Bhakti' or 'Krishna' all the words that dropped from his lips were quite wet with tears. At this stage of his spiritual development he very often beheld the cloud-coloured Krishna with a bamboo flute on his lips and dancing on the head of a cobra, face to face, with his eyes open and his senses all about himself.

7. (i) Jagad Guru's reception and Vedanta.

His Holiness Jagadguru Shri 1108 Shri Raj Rajeshwar Tirtha Swamiji, Shankaracharya of Sharada Matha, Dwarka, Kathiawar happened to come in Lahore during these days. He was very proficient in Upnishads and Vedanta and was so learned in Sanskrit language and the Shastras that he had no equal.

Goswami Rama had the occasion to receive him on behalf of the Sanatan Dharma Sabha and had full opportunity to enjoy his blessed company.

His intense devotion to Krishna now changed its direction and worked with an equal force in search of self-realization as taught in Vedanta.

He now began to make a thorough study of the Upnishads the Vadanta Sutras and other books on Vedanta, and determined to pass his summer vacation in Hardwar and Rishikesh for spiritual exercises and deep meditation on Self.

Hence in August 1897 he hired a house by the Ganges side in Hardwar and began to enjoy the bliss of deep meditation in solitude (realizing in practice what he studied about Vedanta in theory)

(ii) Mental Renunciation.

Thus by continued practice, his spiritual bliss developed to such a pitch that on October 25th 1897, the Diwali day, it led him spontaneously to make a total self-surrender or renunciation of all and he wrote to his father to the effect that Rama had on Diwali day gambled away his body for the Real Self.

After this Rama was ever absorbed in contemplation of the Self or Atman and knew not day from night but the One Supreme Realization or the search after the Absolute Truth.

(iii) Sabha.

At the same time in February 1898 in order to taste of the Sweet Nectar of Divine Bliss in company with others he organized a Sabha at his place called the Advaitámrita Varshini Sabha, which consisted mostly of Sadhus and Mahatmas

It was held once every week and whatever conclusions were drawn from an earnest discussion on Vedanta they were worked upon and

practised by the members in solitude for a week and the experiences related before Rama in the next meeting for further instructions. Thus Rama became more and more absorbed in the real Bliss and nothing could shake him from his concentration of mind and inner peace.

8. First Tract. Although outwardly he was sometimes very busy but inwardly he enjoyed the eternal peace. It was during these very days, in 1898, that for the benefits of the student community Rama delivered a lecture on Mathematics, which was afterwards published in the form of a pamphlet and called "How to excel in Mathematics"—the treatise now published again in the present form. This was his first English speech and written work and it was followed by writings in different languages

9. Vast Studies. He had such an intense devotion to study that a whole library of books on religion and philosophy of the west was mastered in a short time The Rishis of the Upanishads, Patanjali Jaimini, Kanad Kapila Gautama Vyas, Krishna, Shankara were as much at his fingers' ends as Hafiz, Attar, Shams Tabrez and Maulana Rum Kant, Schopenhauer Fichte and Hegel, Goethe and Carlyle were as familiar authors as Tulsi Das,

Sur Das, Kabir. Tuka Ram and Nanak who were undoubtedly his inspirers. He was perfectly at home in Persian English, Hindi, Urdu and Sanskrit Literatures. He studied the four Vedas in 1906, and was a master Pandit of every Mantra, whose every word he analysed with the acute accuracy of a philologist. Not only had he a mastery over literature but was a keen student of Science and Mathematics. He loved Science and was an amateur chemist and botanist. His special study in the Philosophy of Science was Evolution. He enjoyed the scientific candour and truthfulness of Spinoza, Spencer, Darwin, Haeckal, Tyndal, Huxley, and Professor James Thus he made himself quite a prodigy of learning. It seems every minute of his thirty-three years was so well utilised. He was very hard working till his last moments.

While in America he went through, in two years, in spite of his strenuous public labours, almost the whole range of American literature taking a particular delight in the free chants of Walt Whitman and Thoreau.

10. Character and Personality.

" He was in a strange humour. all his own when he judged all the world's authors, prophets, poets and mystics. There was no pedantry and not the slightest shadow of affected

pride or anything unreal when he acted like an impartial judge in his own way. He was a scholar, scientist and spiritualist of a very high order in one. Simultaneous with his intellectual culture, he had brought his spiritual development to a very high pitch. Crowded Lahore could no more satisfy the amptitudes of his soul. Whatever time he could get he would spend in the Himalayan hills and jungles, meditating on the Upanishads and the secrets of the Ancient Aryan "*Brahm vidya.*"

II. Realization.

"It was in the forests of Brahmapuri, near Rishikesh, in 1898, that Rama realized his object,—the Atman, the Self He went there all alone, and without any thing but a few Upanishads. Again and again he went over them and meditated by the Ganges side on bare rocks day and night, little caring for rain or sunshine but all absorbed in the one thought of self realization.

He had determined to lose his very life in the attempt or to gain it and he did succeed.

He attained to that fearless, blissful *oneness* state of mind where there is no more delusion or repentence and knowing or rather realizing which nothing remains to know.

The inner fountains of Divine Bliss were now incessantly and spontaneously flowing out of him and shedding benediction all around him. Shrutis and Smritis verses and songs thoughts and things, questions of philosophy and Religion, politics and society, whatever now came from him, were changed by the mysterious effects of his inner soul and came out with refreshing beauty a new form, wearing garment of Rama consciousness. He saw the Universe in Himself and himself in the Universe. He enunciated the great law that the whole Universe serves one as his body, when he feels the Universal soul as his very self.

12. Exercise. Not only a spiritualist and a veritable prince of all Oriental dreamers and Yogis, he was a great champion of physical exercise. He delighted in designing new methods of physical exercise He could never forego his daily exercise He was seen even a few minutes before his death, taking as was his wont, his physical exercise, Thus out of a thin, frail body, he managed to emerge a strong man of staglike nimble activity. He was a great and swift walker He could walk more than 40 miles a day as a Swami in the Himalayan hills. He won in America a 40 miles race, which he ran out of fun in competition with some American soldiers coming two hours ahead

of the winner. He scaled Gangottari Yamunottari and Badari and Kedarnath peaks clad in a small strip of a loin cloth and a blanket. He crossed from Yamunottari to Gangottari through glaciers. He lived in snows, slept in caves in thick dreary jungles all alone. He would roam about at midnight in dark jungles defying death and fear. He was so fearless so bold. so vehement so strong and so roseate and yet he was so gentle unaffected, child-like pure and noble, sincere, earnest and unassuming that all who came in contact with him with a heart yearning for the truth could not but receive inestimable benefit. After each lecture or class lesson questions were put which were always answered so clearly and concisely, sweetly and lovingly. He was ever filled with bliss and peace, a constant spring of happiness and ever chanting the sacred syllable Om when not engaged in talking, writing or reading. He saw divinity in each and all, and every one was addressed by him as " Blessed Divinity."

Free, free was he like a child and saint. He would remain in God consciousness for days together. His unfaltering devotion to India and his desire to raise her benighted people was indeed perfect self-abnegation.

His personality may be described as explo-

sive. He would remain silent for
13 Personality. months together as if he had nothing to say. He remained merged in joy All of a sudden he will burst out like a volcano and give out his thoughts in a wild manner. Whenever he spoke or wrote one could be sure of getting something very refreshing and original His highly cultivated emotion, bold independence of thought and his great towering intellect formed an attractive feature of his personality He was deeply sincere and irresistably sweet. Mahomedans and Hindus loved him alike To see him was to feel inspired with new ideals, new powers, new visions and new emotions.

Whatever he taught, he had not only thought upon. but he had actually
14. Doctrines and Views. seen its working in his own life. He used to say that he believed in *experimental religion.* According to him the art of living consists in *luminous belief* Just as in science, authority has little weight in arriving at Truth, so in religion authority should have little or no weight and its truth must be tested by trusting your life to it. Every one must reach the inner man, the Self, the Atman, through the failures and successes of his own life or through Self-Realization. Life itself is the greatest

revelation. The great idea which runs as an undercurrent in all his discourses is the renunciation of body consciousness (Ahankara) and the realization of Self to be the Self of universe. The false ego is the cause of all limitations. Eliminate it and the spirit of man is the universal spirit pervading everywhere and everything This higher life is to be realised and Rama sanctions all means by which it may be attained. The bed of thorns or the bed of roses whichever induces the state of realisation in us is to be blessed. Total self-abnegation is the essential prelude to this realisation and it may be effected by different individuals in different ways. Hence he gives only the general outlines of his main conclusions and sketches the methods which were most helpful to him

15. Ideal.

Vedanta is to him by no means a mere intellectual assent but a most solemn and sacred offering of body and mind at the holy altar of Love. Rama's Vedanta is the beautiful calm of that super-consciousness which transcends the limits of body and mind where all sound dies, where the sun and moon get dissolved, where the whole cosmos ripples like a dream and is eddied into the Infinite. It is from here that he throws the

ladder for us to reach him and see the sights of the world below Perennial peace is diffused there and the man is entirely lost in God All discussion ceases there And those who are there simply look around and smile and say to every object ' thou art good " ' thou art pure " ' thou art holy " ' thou art That "

" Neither the sun shines there, nor sparkles the moon.
Pranas and Sound are hushed into silence,
All life reposes in soul s swee slumber,
No god. no man, no cosmos there, no soul,
Naught but golden Calm and Peace and Splendour.

In the summer vacation of 1899 he went to make a pleasure trip in Kashmir.

16 (i) Journeys. He visited Shrinagar and thence went on a pilgrimage to Amar Nath also. On his return in the end of 1899 he suffered from fever and colic pain to such an extent that one night no hope remained of his life when he lay senseless during the night But nature had something different in store and so he was alright the next day Thereafter he desired that his thoughts and ideas should reach the public as soon as possible For this an Urdu magazine called "Alif" was started and continued for some time from a new press called Anand Press managed by Swami Narayana and supported chiefly by L Har Lal He took great

delight in writing original articles to this magazine, so much so that he now wanted to leave off his two hours service in the college also. In the meanwhile having a desire to see the sea he went to Karachi and Sukkur where he was honorably received by some kind admirers and passed a few day there in great pleasure although he did not take with him a single pie. After the issue of the 3rd No of his magazine Alif, he was so saturated with spirituality and overfilled with it that he could no longer remain shut up in his household or the crowded towns.

(ii) Vanprastha Ashram.

So in July 1900 he resigned his service and went to jungles along with a few companions including his wife and children. All of them reached Hardwar and thence they went to Tehri by way of Devaprayag. There they took up their abode in a calm, quiet and lonely but very charming place in a garden by the side of the Ganges.

(iii) True Faith and Incident.

Here Rama ordered his companions to throw away all the cash if they had any into the Ganges and keeping faith in God to sit all absorbed in Him Who alone maintains and takes care of all. He said that if any of them suffered from any want it would be only due to his own want of full faith

in Him and if so it would be far better for such a one to die than to live a miserable life wanting in faith in the Creator.

It so happened the same day that Swami Rama Nath, the manager of the Calcutta Kshetra of Rishikesh was touring about in connection with the arrangements of Kshetras of Gangottari route. He heard about Rama and came to visit him in the garden.

On seeing him all absorbed in God-consciousness, he, of his own accord, ordered the shop-keeper, who accompained him, to supply rupees ten worth of corn every month to these men engaged in spiritual exercises.

After this strange incident, all of them were struck with wonder and a firm faith in God took hold of them for future, more than ever. All of them began to practise meditation etc, with full faith and thorough concentration and Rama now began to contribute to 'Alif' with a greater zeal and fuller energy.

One night Rama, all of a sudden, left all sleeping and went out all alone in the midnight towards Uttar Kashi. When walking or rather feeling his way out in the dark Himalayan gorge; at a time when all was silent, the clouds gathered

in the lightening flashed forth and the rain burst out in a storm over the lovely traveller, bare-footed, bare-headed, no umbrella, no clothes, save a single dhoti. But on and on he went until he saw the very path give way before him under the heavy deluge and torrents of water rushing over the steep rocks And yet Rama was not to be daunted. He scaled and climbed the mountain side catching hold of the grasses and boulders a feat which even a mountain goat could not possibly do under the conditions. In a moment he had crossed the gulf and was shouting on the top of a hill by himself Om ! Om !! Om !!! Nothing could harm nothing could dare injure One who had realized himself to be one with the Universal Self. Even Death itself had to await his orders.

On his sudden absence, Rama's wife felt the shock very keenly and fell down in illness from which she could not recover herself even after Rama had come back a few days after And so she desired to go back to her home along with her young son Brahmanand. She was therefore ordered to go back in care of Swami Narayana who took her to the plains and returned back.

After a period of 6 months of solitary life in the jungles, in the beginning of 1901, just a few days before the passing away of Swami Viveka-

(iv) Sannyasa Ashram.

nand, Rama desired to take Sannyasa. He had the permission of the Shankaracharya of Sharada Matha to take Sannyasa by the Ganges side when he might find himself qualified to do so.

It was now in the midst of the Ganges that he made over charge of his sacred thread to the rushing current and put on his orange robes with a continuous chant of the sacred syllable, OM! OM !! OM !!! After this he remained wrapt in deep meditation and Anand for hours together at the banks of his dear Ganges.

Gosain Tirtha Rama was now Swami Rama Tirtha, having come in the order of Tirtha Sannyasa of the Sharada Peetha—Dwarka and hereafter he began to live all along by himself in the same jungle allowing nobody to see him except on very rare occasions

17. Further travels in Himalayas and plains.

After a six months residence here, as many people began to come for his visit, he changed his place on 14th June 1901 to a cave about 4 or 5 miles away and after a few months more he left this place also on 16th August 1901 with Narayana and L. Tula Ram for Yamunottari, Gangottari Triyugi Narayana, Kedar Nath and Badari Narayan. For a month they lived in Yamunottari, near the hot springs in a cave and a

wooden house and also made an ascent over the Sumeru Mount, the white snowy peak at the sources of the river Yamuna After this they crossed over snowy hills by a narrow path, direct but dangerous over which no pilgrim could venture and reached Gangottari on the 3rd day instead of 10 or 12 days usually taken by others by the ordinary path. Again after a month's stay at Gangottari they went to Kedar Nath and Badari-Narayan by way of Triyugi Narayan and reached Badari Narayan a week before Diwali.

The return was made in December 1901 by way of Almorah to Mathura where Swami Rama was invited by Swami Shivagan Acharya who had elected him as president of a religious society. Here his lectures were attended by thousands who were so attracted by his personality and all-pervading love that they followed him like Gopis following Krishna over shrubs and rough ground and sat down on bare ground to listen to him by the Yamuna side till late in the winter night Thence he was invited by L. Surjan Lal Pandey to Fyzabad in the second annual meeting of Sadharan Dharma Sabha in February 1902. After that in May 1902 he retired into the thick jungles of Tehri State in the Himalayas once more for meditation in solitude.

Here once the Maharaja Saheb of Tehri, while on his way to Dehradun happened to touch the skirts of the forest where Rama was residing and on hearing of Rama Maharaja Saheb felt very anxious to see him. He had become agnostic through the influence of some Western philosophy like that of Herbert Spencer and did not believe in the existence of God On meeting Rama all his doubts were dispelled one by one during a long continued talk and after that he requested Rama to grace Tehri for his sake which Rama accepted with pleasure.

18. Foreign Travels.

In July 1902 it was published in the newspapers that a Religions Conference was going to be held in Japan in which all the religious Leaders were invited to attend Maharaja Saheb of Tehri requested Rama to go to that Conference and preach Vedanta Rama accepted the request and Maharaja Saheb made all the arrangements for Rama's voyage through Thomas Cook & Co. Rama went to Calcutta alone but when people insisted much on his taking a companion Swami Narayana his disciple was taken with him.

(1) Japan

They left Calcutta for Japan on 28th August 1902 During the voyage they touched Penang Hongkong Shanghai Naga Saki and finally

Yokohama. They were cordially received by the Sindh merchants at these ports and had a week's halt at Hongkong for a change of ship and Rama lectured there to the all attentive and interested audience On reaching Japan they learnt that there was no Religious Conference there and that it was all wrong news. However, they proceeded to the capital Tokyo to ascertain the facts for certain and met there many Indian Students who had come to learn arts and sciences in Japan Rama happened to meet with Mr. Puran there who had just started an Indo Japanese Club for the promotion and help of Indian Students in Japan and who was appointed its Secretary Rama also gave a lecture on Secret of Success in Tokyo College which produced a deep and lasting effect on the hearts of the Students and Professors.

Professor Chhatre's Circus happened to be there at the time who became an ardent admirer of Rama and on his request Rama accompanied him to America Here Mr. Puran being deeply effected by Rama's speeches tookSannyas to serve all humanity and roamed about in all the Japanese towns and also issued a magazine "Thundering Dawn", but on his return to India he again became a householder and subsequently a sikh (his.

family religion) while Swami Narayana who had accompanied Rama upto Japan was advised by him to travel in a different direction preaching Vedanta, *viz.* Burma, Ceylon, Africa and Europe.

(*ii*) America.

Rama when he reached America gave a number of lectures sometimes for three hours together of which the shorthand notes were taken by the Americans and typewritten copies presented to Rama. Those copies were afterwards printed in India in the form of four volumes called "In Woods of God-Realization" In America, where everything is sold and has its value in dollars Rama never allowed his lectures to be attended by Tickets although it cost a good deal to hire halls for his lectures. This in itself is a testimony of how much the Americans loved Rama and appreciated his lectures. Rama accompanied Prof Chhatre upto Siatle, Wash but after that the Americans made him their own guest and one of them Dr. Albert Hiller served him with all heart and mind for about a year and a half at San Francisco Some of the Americans moved by Rama organized Societies for the help of the poor Indian Students in America and also to gain daily Spiritual food from the society of Rama they organized a body called the Hermetic

Brotherhood The Americans became so much enamoured of Rama that they took his photo like that of Christ and published it in the Papers under the heading "Living Christ has come to America." The President of the United States also came to visit Rama and although the Millionaires of America liked to put him up in their palatial buildings Rama liked forests more and always used to take his abode on some mountain side far away from the busy haunts of mankind and roamed about in a single thin cloth even in the icy cold of North America living simply on nuts, fruits, vegetables and milk.

He was full of unresistable joy and laughter and nobody could remain sorry in his company. All doubts vanished like vapours before his sunny face. Once an American lady, a resolute atheist came to discuss with him but on seeing Rama all absorbed in Samadhi, she waited in and when Rama came to his normal consciousness she broke the silence with the words "My lord I am not an atheist. My doubts have disappeared on seeing you"

Mrs. Wellman, another American lady, loved and admired Rama so deeply that she renounced all Western dress and putting on the Sanyasi's Orange Pobes she wandered from town to town

without any money but with full trust in God and coming to India visited with great pleasure, the birth place of Rama, the village Murariwala in the district Gujranwala of Punjab Such was the Universal love of Rama that it not only moved the hearts of Americans but when he was in Egypt on his return in Cairo he bewitched the hearts of Mohamedans by his lucid lecture in Persian and was called by them the Hindu Philosopher

19. Return to India.

About two and a half years travel in foreign countries Rama returned to India and landed in Bombay in 1904, His first lecture on his return was organized in Bombay, whence he made a tour through Agra, Muttra and Lucknow to Pushkar-raj in Ajmer, giving his worldwide experiences to the all expectant audience Arya Samajis, Sanatan Dharmis, Brahmo Samajis, Sikhs even Christians and Mahomedans all alike joined his reception wherever he went. and when asked to start a new society he simply answered that all societies were his own and that he would work through them.

He loved mother India so much so that he realized himself as India incarnate and professed that within 10 years India would get practical Vedanta and that love would conquer hate to unite man s hearts.

In the meanwhile Swami Narayana leaving Japan visited Singapur, Penang, Burmah and Ceylon After that he went to Africa, visited Port Said Cairo (Egypt), Alexandria Gozo, Malta Tunis Algiers, Morocco and Gibralter etc, and lastly reached London in September 1903, where after about a 5 months' stay he fell ill owing to the severe winter and was advised to leave London at once He therefore in January 1904, on receiving orders from Rama returned to India and reached Bombay in July 1904 six months before Rama's return, and in October 1905 when Rama went to Hardwar after a tour in Bengal and U. P and fell there ill he came to him from his tour Rama was dangerously ill for over a week and when recovered went to Muzaffar Nagar for a change of climate and sent Narayana to Lucknow.

20. Narayan's Travels.

After regaining health Rama desired to seek solitude and called Narayana back. Hence in November 1905 Rama and Narayana went by way of Hardwar and Rishikesh to Vyas Ashrama a very fierce and lovely forest on the other side of the Ganges where Rishi Veda Vyas, the author of Mahabharat, is said to have performed his tapas.

21. Himalayas again.

There they passed their winter of 1906 in lovely straw huts, a couple of miles distant from each other and Rama studied and meditated over Nirukta and Sama Veda.

In the summer they moved on further to Devaprayag Tehri, and went to Vasishtha Ashram, a place about 12 or 13 thousand feet high above the sealevel and 50 miles far from Tehri where Rama began to live in the cave of Vasishtha Muni in March 1906, and sent Narayana in his place to the plains to lecture in the various meetings wherever he was invited But Rama's body soon fell ill and Narayana had to come back after two months. On his arrival they shifted their habitats by a few miles more experimentally so that Rama now began to live in a cave at a greater height while Narayana moved down in the valley. The scenery round this cave is described by Rama in his letters as the "Garden of Fairies."

There was another cave above this which was occupied by an enormous snake (Azdaha) while another cave across the valley and just opposite to Rama's was the den of a large tiger who used to look at Rama from his place and sometimes passed by Rama's cave also which was a large and open one. This cave was quite

unprotected either from wild beasts, of which there was no fear for Rama whom beasts and men all obeyed in his universal love or from rain which really proved a nuisance specially when the rains set in and wetted all the clothes, and goods and keeping Rama awake during the nights.

He had therefore to quit this place also and came down to the plain in the valley where the hill-men at once constructed for him a Kuti (small hut.- Here Mr. Puran with two companions came to see Rama in his Vasishtha Ashrama and lived for about a month. Rama was at this time taking for food only milk as the local grains did not suit him and on the arrival of these guests he was pressed by them to take some grain food also. He did so, moved by their love but he as well as the new comers fell down sick with dysentry and fever They then asked Rama to move down to plains which he accepted with the limitation not to go beyond Tehri Hence Narayana went to make the necessary arrangements for departure and Mr. Puran accompanied him to return to the plains

Rama also walked with them for a mile and in the way told Mr Puran that Rama may soon have his pen at rest and his tongue silent as he

22 Forebodings.

had become too weak and that he may perhaps no more visit the plains Hence he advised that they should now themselves become Rama and read, write and work all absorbed in Him These remarks brought down a stream of tears n.their eyes and it really proved the last meeting with Rama of Mr Puran

Now in order that the place may not be shifted too often Rama searched for a solitude fit for every season at the banks of the Ganges somewhere near Tehri. He did find such place where some Mahatmas had lived for long and which was in a solitude surrounded by the Ganges on three sides. Here Maharaja Saheb of Tehri had at once built for him a Kuti according to Rama's own plan.

23. Last Solitude.

Narayana was now told by Rama to go to live in Bamrogi cave some miles away where they had once previously stayed for some time, and was advised by him to come to see Rama weekly on Sundays unless specially called When sending off Narayana to the cave Rama accompanied him for over a mile even bare footed and bare-headed and on reaching the road addressed him with the same remark, as to Mr. Puran that it may probably soon happen that Rama's pen may cease to run and his tongue may stop to speak. That Rama no more

felt inclined to touch any worldly work and may never leave the Ganges side to go down to the plains again. That wherever he might be invited Narayana will have to go and hence he should dive himself deep in Real Rama while in the solitude cave and come out of it all heart, body and soul transformed into Rama or Vedanta incarnate.

24. The sorrowful message and end.

Narayana had not lived there for five days, when suddenly a messenger came there and brought him the most heart rending news of Rama having been carried away by the Ganges while bathing in it. Rama, while exercising against the rushing waters of the Ganges as was his wont, this time rather in deep water was suddenly carried away into a whirlpool where he struggled long and though finally came out with a strong dive, but being exhausted was carried away further to midcurrent where at last he left his body uttering loudly Aum ! Aum !! Aum !!!

25 Last Note.

Narayana and Mr. Puran afterwards found his last written passage on the table which ran as follows:—

" O Death ! Take away this body if you please ! I care not I have enough of bodies to use. I can wear those divine silver

threads. the beams of moon and live. I can roam as divine minstrel, putting on the guise of hilly streams and mountain brooks

I can dance in the waves of sea I am the breeze that proudly walks and I am the wind inebriated. My all these shapes are wandering shapes of change. I came down from yonder hills raised the dead awakened the sleeping. unveiled the fair faces of some and wiped the tears of a few weeping ones. The Bulbul and the rose both I saw and I comforted them. I touched this I touched that, I doff my hat and off I am Here I go and there I go, none can find me I keep nothing with me."

OM ! OM !! OM !!!

MATHEMATICS

Its Importance

AND

THE WAY TO EXCEL IN IT.

THE IMPORTANCE OF THE STUDY

OF

MATHEMATICS.



I am fully aware of the difficulties which I shall have to encounter in trying to enlist your interest in what is commonly called ' a dry subject.'' The usefulness of the study of Mathematics sounds like a paradox to the superficial observer. An ordinary man cannot help putting such questions as :—

(*a*) Why should we bother our heads about the 47th Proposition of Euclid's First Book ?

(*b*) Of what use in the world can the Binomial Theorem be ?

(*c*) Why should we spend a considerable portion of our life at a, b, c, and long s (*ʃ*) ?

(*d*) What is the use of dealing with the Greek Mathematical signs ?

1. The inability to answer questions like these or the apparent uselessness of Mathematics makes this study very unpopular.

2. Another reason why it is disliked is that it is a very hard subject which taxes both the memory and the intellect ; it is difficult to understand and more difficult to remember To read it is not like walking on a smooth paved road ; but here the path is, so to speak, both slippery and rough, presents many stumbling blocks and rubs in the way.

3. A third reason why Mathematics is felt so heavy and tedious is that generally it is not administered in proper doses or in an agreeable form ; in other words, teachers do not always try to make it attractive. Carbon dioxide swallowed as in soda-water, in conducive to health ; but inhaled, it injures the system. Just so, Mathematics does us good only if taken or studied in the proper way.

Students as a rule, complain against the University because Mathematics is made a compulsory subject in some examinations, they blame the Syndics and have all sorts of hard names to give to Mathematical writers.

To begin with, let us, for the sake of argument assume that Mathematics has really no reward to offer, has nothing to pay. But, dear friends, let us not in whatever we undertake, be led and guided by a desire of reward. This

mercenary spirit ought to be checked. The event or fruit of any action ought not to influence us; let us do whatever we engage in, goaded by a sense of duty and not drawn by the bright future :—

If duty calls to brazen walls,
How base the fool who flinches.

Let us work into life the following advice of the author of Bhagwad Gita:—

"............................ Find full reward
Of doing right in right! Let right deeds be
Thy motive, not the fruit which comes from them,
And live in action! Labour! Make thine acts,
Thy piety.............. ...."

Learn to acquire knowledge for its own sake; hunger and thirst after knowledge. Learn a lesson from the life of Old King Ulysses who with one foot in the grave wooes knowledge and asks his followers

To follow knowledge like a sinking star,
Beyond the utmost bound of human thought.

The assumption above made is far from being correct. The advantages of Mathematics are very many. They do not lie on the surface, but are hidden and concealed —

(*i*) Mathematics is like the ocean rough, boisterous, and fearful on the surface;

but having precious pearls, and gems of the purest ray serene at the bottom; or

(*ii*) it may be compared to the statues of the old satyrs and sileni of Greece ; repulsive figures to look at but enclosing within them the finished and fascinating statues of the most beloved gods of the Greeks.

(*iii*) Like the solar light it appears quite colourless to the unthinking multitude, while it is in reality composed of the colours of the rainbow.

Mathematics (*Gr*. *Mathé-Matiké*) in its ginal sense signifies " skill, knowledge or science." And in all its subsequent developement it has had the idea of " skill, knowledge or science" always underlying it. It is in no small measure to *Mathematics* that the world owes its Sciences of Astronomy, Optics Acoustics, Statics, Dynamics, Hydrostatics, Hydrodynamics Thermodynamics, Magnetism, etc ; and the Arts of Navigation, Engineering, Architecture, and the like.

Mathematics is well called an *exact science* and a sure and certain branch of knowledge (*cf*. the phrase " Mathematical certainty)."

"Geometry," Pascal observes, "is almost the only subject in which we find truths wherein all men agree; and one cause of this is that geometricians alone regard the true laws of demonstration." So Geometry or Mathematics, we may say, has been like that solid and substantial food to science which goes for the most part to form bone or the supporting element. According to Roger Bacon, Mathematics is the "gateway and the key to other sciences." Professor Ball says —"It is interesting to note that advance in our knowledge of Physics is largely due to the application to it of Mathematics, and every year it becomes more difficult for an experimenter to make any mark in the subject unless he is also a Mathematician."

What generally happens is that the Mathematician takes the results of some every-day observations and raises on them splendid superstructures which attract the attention of the Experimentalist, who steps forward and verifies by experiment the results thought out by the Mathematician. Then the labours of the two combined enrich the world with inventions and discoveries; give to it its railways, telegraphs, balloons and what not. Happy the man who is a Mathematician and Experimentalist in one.

"The most general division of Mathematics," says Herbert Spencer, "dealing with *number* guides all industrial activities, be they those by which processes are adjusted, or estimates framed or commodities bought and sold or accounts kept. No one needs to have the value of this division of Abstract Science insisted upon."

"For the higher arts of construction," the same writer continues to say "some acquaintance with the more special division of Mathematics is indispensable. The village carpenter who lays out his work by empirical rules, equally with the builder of a Britanica-Bridge, makes hourly reference to the laws of space-relations. The surveyor who measures the land purchased; the architect in designing a mansion to be built on it; the builder when laying out the foundations; the masons in cutting the stones; and the various artizans who put up the fittings; are all guided by geometrical truths. Railway making is regulated from beginning to end by geometry; alike in the preparation of plans and sections; in staking out the line; in the mensuration of cuttings and embankments; in the designing and building of bridges, culverts viaducts, tunnels, stations. Similarly with the harbours, docks, piers and various engineering and architectural works that fringe the coasts and

overspread the country as well as the mines that run underneath it And now-a-days even the farmer, for the correct laying out of his drains, has recourse to the level—that is, to geometrical principles.

" On the application of Mechanics (a branch of Applied Mathematics) depends the success of modern manufactures The properties of the lever, the wheel-and-axle, etc, are recognised in every machine, and to machinery in these times we owe all production." The following is the case in England and will in no long time be the case here too :

"Trace the history of the breakfast roll The soil out of which it came was drained with machine-made tiles ; the surface was turned over by a machine ; the wheat was reaped, thrashed and winnowed by machines ; by machinery it was ground and bolted ; and had the flour been sent to Gosport, it might have been made into biscuits by a machine. Look round the room in which you sit. If modern, probably the bricks in its walls are machine-made and by machinery the flooring was sawn and planed, the mantel-shelf sawn and polished, the paper-hangings made and painted. The veneer on the table, the turned legs of the chairs, the carpet, the curtains are all product of machinery.

"Your clothing—plain, figured or printed—is it not wholly woven, nay, perhaps even sewn by machinery? And the volume you are reading, are not its leaves fabricated by one machine and covered with these words by another? Add to this that for the means of distribution over land and sea, we are similarly indebted. And then observe that according as knowledge of *mechanics* is well or ill applied to these ends comes success or failure. The engineer who miscalculates the strength of materials, builds a bridge that breaks down. The manufacturer who uses a bad machine cannot compete with another whose machine wastes less in friction and inertia. The ship-builder adhering to the old model is outsailed by one who builds on the mechanically justified wave-line principle. And as the ability of a nation to hold its own against other nations depends on the skilled activity of its units, we see that on mechanical knowledge may turn the national fate."

Let us now see to whom most of the modern inventions and discoveries of which the world is so proud owe their origin?

By whom was the first *Steam-engine* made?
James Watt, a Mathematical Instrument maker.
By whom was the *clock* invented?

Galileo a Mathematician.
By whom was the first *telescope* made ?
Galileo a Mathematician.
By whom, the Barometer ?
Pascal a Mathematician.
Who found out the amount of alloy in the golden Crown of King Hiero of Syracuse ?
Archimedes, a Mathematician
Who was it that discovered the Law of of Gravitation ?
Newton, the prince of Mathematicians.

In a word, directly or indirectly almost all our conveniences and articles of comfort are due to this branch of Philosophy or Science which we call Mathematics.

Professor Adams, the Mathematician foretold the existence in the heavens of satellite not known to the world before, and *then* the practical astronomer actually discovered the same.

Mathematics enables us to calculate accurately distances, billions upon billions of miles in length, as the distances of stars, etc; and it also enables us to measure magnitudes about one billionth part of a cubic inch in volume, like the size of a molecule or atom. From finite quantities it leads us on to the region of the infinite.

By Mathematics we discover some of the Universal Laws of Nature written with incrasible ink on the faces of substances by the unerring finger of the Almighty. In the lines and figures of Geometry we learn ' those characters " to use an expression of Galileo ' in which the great book of the universe is written "

In Statics and Dynamics the Mathematician deals with forces varying according to different laws and in case a new kind of energy should come to light and give rise to forces obeying laws different from those which the forces of ordinary nature obey, the Mathematician will be found fully equipped to receive it; whereas the mere experimentalist if not calling Mathematics to his aid, will be at a loss how to deal with it at the first sight. Let a new fluid be discovered and its fundamental property known; it will find itself already registered in the works on Higher Hydrostatics as an old servant with specified duties to discharge

There is a variety among individuals of all species: again the different species of the same genus are in no instance exactly alike; and the different genera differ widely. So, I persume that different planets of the same Solar System have no monotony and the different Solar Sys-

tems are not alike in every respect They are, in all probability governed by new laws and are blessed with new materials, new liquids and new kinds of Energy. Mathematics embraces the properties of these new things as well as those of the old familiar ones This is knowledge of intrinsic worth.

Its rules and laws govern the phenomena and facts that can ever take place on the background of Eternity. ' The old order ceaseth, yielding place to new" but the Mathematical dogmas remain still controlling all these vicissitudes and undergoing no change in themselves.

Says Herbert Spencer—" of course as those facts which concern all mankind throughout all times must be held of greater moment than those which concern only a portion of them during the continuance of a fashion, it follows that in a rational estimate, knowledge of such facts, being knowledge of intrinsic worth, must, other things being equal take precedence of knowledge that is of quasi-intrinsic or conventional worth."

Hence you can judge of the importance of Mathematics which, beyond doubt, imparts knowledge of the kind of facts here alluded to.

If most people pride themselves on possessing a knowledge of Law, (Law dealing with *matters of this transient world*), why should a knowledge of the eternal laws dealing with all worlds and possibly with the world to come be disdained,

"That very law which moulds a tear,
And bids it trickle from its source,
That law preserves the earth a sphere,
And guides the planets in their course."

This law and many similar laws are treated in the works on Mathematics.

To show that the sphere of Mathematics is not confined to the physical objects alone, but extends over the mental and the psychic phenomena as well, I may refer to the distinguished writers on the Calculus of Probabilities who have applied it to *Belief* and also to Edgeworth and Jevons who have shown it to be capable of application to *Feelings*.

Milton holds that a part of the happiness of the pious will consist in the consciousness of the knowledge which they acquired in this world. If this be true, Mathematics is sure to make you happier in the world to come, as it embodies knowledge of the widest application.

I have been discussing so far the value of *Mathematics as knowledge. Now, let us discuss* its value in the way of discipline. And here, without question, it holds a supreme place.

The Vernacular word for Mathematics is "*Riyázi*" and this very name signifies "pertaining to "*Riyázat*" or discipline" The study of Mathematics involves a mental exercise best fitted for strengthening the faculties.

The advantages of Physical exercise are not apparent to an ordinary Indian boy; and Physical exercise is not so pleasant to him as eatables; being ignorant of the fact that in proportion as he takes more physical exercise, he will enjoy and digest the eatables better. Similarly the advantages of mental exercise involved in the study of Mathematics are not apparent to an ordinary Indian student, and so, he reads Mathematics with great reluctance, not knowing that in proportion as he studies more of Mathematics, he will relish and master other subjects better.

"I have mentioned Mathematics," says Lock, 'as a way to settle in the mind a habit of reasoning closely and in train; not that I think it necessary that all men should be deep Mathematicians, but that having got the reasoning which that study necessarily brings the mind to, they

might be able to transfer it to other parts of knowledge as they shall have occasion "

There are men who are already physically strong, yet physical exercise will make them still stronger Similarly there are men already intellectually very strong yet a study of Mathematics will most certainly add to their intellectual powers.

Rev. Dr. Chalmers has stated : –" I am not aware that as an expounder to the people of the lessons of the Gospel, I am much the better for knowing that the three angles of a triangle are together equal to two right angles ; or that the square on the hypotenuse is equal to the squares of the two containing sides in a right-angled triangle. But I have a strong persuation that both the power to apprehend and the power to convince may be mightily strengthened—that the habit of clear and consecutive reasoning may be firmly established by the successive journeys which the mind is called on to perform along the pathway of Geometrical Demonstration. The truth is that as a preparative whether for the bar or for the pulpits I have more value in Mathematics for the exercise which the mind takes as it travels along the road, than for all the spoil which it gathers at the landing place."

The author of "The History and Philosophy of the Inductive Sciences" has shown in his "Thoughts on the study of Mathematics" that Mathematical studies judiciously pursued from one of the most effective means of developing and cultivating the reason: and that "the object of a *liberal education* is to develope the whole mental system of a man;—to make speculative inferences coincide with his practical convictions; to enable him to give a reason for the belief that is in him, and not to leave him in the condition of Soloman's sluggard, who is wiser in his own conceit than seven men who *can* render a reason."

To this may be subjoined the judgment of John Stuart Mill, which he has recorded in his invaluable system of Logic (Vol II.) in the following terms:—"The value of Mathematical instruction as a preparation for the more difficult investigations (physiology, society government, etc.) consists in the application of its method. Mathematics will ever remain the most perfect type of the Deductive Method in general; and the applications of Mathematics to the branches of Physics furnish the only school in which philosophers can learn the most difficult and important portion of their art, the employment of the laws of the simpler phenomena for explaining and

predicting those of the more complex. These grounds are quite sufficient for deeming Mathematical training and indispensable basis of real scientific education and regarding,. with Plato, one who is *a y e w u e r p u r o s*, as wanting in one of the most essential qualifications for the successful cultivation of the higher branches of philosophy"

The Study of Mathematics strengthens both the intellect and memory and tends to impart to us an assimilative memory rather than a sensuous one inasmuch as it teaches us to remember things by the aid of the intellect or thinking faculties; and discourages us from memorising a demonstration and the like by endless repetition It gives us a Memory which has brought immense wealth to, Professor Loisette. The nature of the subject admits of no such thing as cramming. We cannot cram Mathematics, whatever we learn of it must be got up intelligently.

It is true that Mathematics at first appears to be a very dry subject and most distateful, but for that very reason we ought to study it with zest and zeal. In so doing, we shall be the stronger in will-power "Perhaps" says Huxley "the most valuable result of all education is the ability to make yourself to the thing you have to

do when it ought to be done *whether you like it or not.* It is the first lesson that ought to be learned, and however early a man's training begins, it is probably the last lesson that he learns thoroughly"

The abstruse nature of the subject compels a student to concentrate his attention Mathematics is the best cure for mind-wandering. Bacon says—"If a man's wits wander, let him study Mathematics, for in demonstration if his wits be called away ever so little, he must begin again." Now, if on no other account, on account of this grand virtue which it inculcates, *viz.*, concentration of attention, we ought to value Mathematics. No one who is stricken with absent-mindedness can make his mark in any department of human activity.

The path to proficiency in Mathematics is so rough, and so hard an application is necessary that on the way we lose all our roughness and become perfectly smooth and frictionless, as it were, just as the wooden harrow used in this country becomes smooth by passing over the rough and uneven ground turned into clods by the plough

Now a smooth ball or the like if put in rolling or sliding motion on the College floor will

come to rest very long after a rough ball that was put in motion simultaniously with it So, brains that have lost a considerable amount of their friction by working in the rugged field of Mathematics and have now been smoothed down, so to speak, when once put in motion or set to some hard task will, other things being equal, stop or be tired out long after those brains that have not been similarly trained

Not only does the study of Mathematics thus habituate us to steadfastness and perseverence, but it engenders in us a strong inclination to work. It tends to make us bitter opponents to inaction, it stores in us immense energy. The student of Mathematics being compelled to work very hard and long for the sake of success in his subject, goes on working hard even after this impressed force is withdrawn, being then impelled by the energy accumulated in him just as a railway train continues travelling for a long time even after the steam is shut off But alas! for the rash youth, who no sooner are set free from the great motive power —Mathematics or some other branch of learning—and enter life, than they come to a dead stop on account of the brake of sensual indulgence; or at least get their motion considerably retarded by that brake.

Mathematics, startling as it may sound, aids Religion in a most remarkable manner and strengthens the foundation of moral character. Every now and then it puts us in a most humiliating mood, it makes us realize our own incapability, it repeatedly brings us face to face with something which we think we cannot surmount. It makes us humble and meek It tends to do away with our vanity and self-conceit. It breaks us down and consequently exercises the will of God on us "Do you," says. Theodore, Monod a French divine "know what is God's chief difficulty with us? It is not the making us, it is the breaking us It is not the edifying us it is the putting us down, And therefore it is that God's chief instrument for edification is the pick-axe He must break us down, down, down. and whatever he gives us to do for His service He will first of all show us that we are not able to do it O God, take me, break me, and make me." The value of Mathematics in this respect is well pointed out in the following remark by Lock:—' A man in the study of Mathematics will see that however good he may think his understanding yet in many things and those very visible, it may fail him This would take off that presumption that most men have of themselves in this part and they would not be

apt to think their minds wanted no helps to enlarge them, but there could be nothing added to the acuteness and penetration of their understandings." All this shows that the sharp discipline to which it subjects a man has a wonderful influence in smoothing down his asperities in accustoming him, as a rule, to the habits of patience, perseverance, self-denial and humility.

"True science," says Huxley, (including Mathematics undoubtedly), and true religion are twin sisters, and the separation of either from the other is sure to prove the death of both. Science prospers exactly in proportion as it is religious; and religion flourishes in exact proportion to the scientific depth and firmness of its basis. The great deeds of philosophers have been less the fruit of their intellect than of the direction of that intellect ....by an eminently religious tone of mind. Truth has yielded rather to their *patience*, their *love* their *single heartedness* and their *self denial* than to their logical acumen."

Isaac Todhunter in his Essays on Education says that of all the subjects required for passing University Examinations, Mathematics furnishes the most reliable test of a man's working powers.

A student may do remarkably well in the Examination in a language; and yet this may have been owing to his keeping constant company with a man who always speaks that language and is a thorough master of it. A student may distinguish himself in History in some Examination, and yet this may largely be due to his *passively* hearing other students while they were preparing that subject for their Examination. A man may obtain very high marks in a Practical Science Examination; and yet this may be on account of his having familiarized himself with the Science-Apparatus and its use for *amusement s* sake. And so with the other subjects. But a man who excels in Mathematics could not have done so, except by dint of hard labour. He proves himself capable of facing difficulties and doing his duty well, however disagreeable that duty may be.

Nothing particular has as yet been said about "problems" as against "book-work" in Mathematics. They are hard nuts to crack for the student. But once cracked they yield an ambrosial kernel; and the student thus derives an exquisite pleasure from the sweets of intellectual conquest. No other branch of knowledge can present a like phenomenon. After a hard

problem has been solved you will often observe the Mathematician's eye brighten and at length. with a pleasure (of which the ecstacy of Archimedes was but a simple expansion) hear him explain, "I have got it I have got it"

It may not be out of place to say something as to how charming and fascinating this subject has been to some persons or to what extent people of yore have been impressed by its importance. *Plato* loved it to such a degree that the inscription over the entrance to his school ran— " Let none ignorant of Geometry enter my door", and on one occasion an applicant who knew no Geometry is said to have been refused admission. It is related of a Mathematician that while he was absorbed in solving some problem the besieged city in which his house lay was taken by the enemy, and to the spot where he sat musing, came up with a drawn sword in hand a soldier who was about to break the slate of his life. The Mathematician who had been quite ignorant of the capture of the city, did not even now, lift up his head and look at the soldier. The astonished soldier shouted at the top of his voice to make the poor victim prepare for death At this the Mathematician raised his eyes and said: ' Wait a moment ; I am about to solve it" (the problem). The city was captured by the

enemy, but his heart had been captivated by Mathematics

Sir Isaac Newton oftentimes, when busy at some Mathematical theorem used to forget taking his meals I may add two amusing anecdotes: —(1) Newton invited a friend to dinner and forgot it The friend arrived and found the philosopher in a fit of abstraction Dinner was brought up for one. The friend, without disturbing Newton, sat down and depatched it Newton recovering from his reverie looked at the empty dishes and said: ' Really if it wasn't for the proof of the contrary before my eyes, I could have sworn I had not yet dined" (2) Once when riding home from Grantham he dismounted to lead his horse up a steep hill, when he turned at the top to remount he found that he had the bridle in his hand, while his horse had slipped it and gone away.

Galileo had very long been purposely kept in ignorance of Mathematics, but one day, by chance hearing a lecture on Geometry, he was fascinated by the Science that he thenceforward devoted all his spare time to this study, and finally he got leave to discontinue his former studies. He preserved his enthusiasm for the subject in tpite of poverty public ridicule, and persecuson.

And so did *Kepler* notwithstanding domestic troubles, poverty and other inconveniences.

Archimedes could not disengage himself from Mathematical dreams even when walking or when bathing as is evidenced by the well-known story which says that *Archimedes* one day while taking his bath was so much elated at the discovery he then made that unable to contain himself he immediately ran almost naked into the street crying Eureka, Eureka ' I have found it, I have found it."

It is related of *Euler* that even in the perusal of Virgil's poetry he met with images that would recall the associations of his more familiar studies, and lead him back from the faity scenes of fiction to the element, more congenial to his nature, of Mathematical abstraction.

Amongst the ancient Hindus, Mathematics was so extensively loved that even their females were well versed in the subject.

Amongst the rich, Mathematics has exercised its sway over Boyle, Cavendish, Napier, Lord Kelvin, and others. Amongst men of letters Milton, Bacon, Locke, Carlyle, Helps, Froude .... and many others may be counted among its fervent admirers, if not votaries.

Perhaps some of you can 'still see no connection between abstract and practical science, and hold the former in little esteem, despising mental discipline unless you perceive its direct reference to the actual business of life, and so reject Mathematics as of little practical interest, calling it with Alexander Pope as—

> "Tricks to show the stretch of human brain,
> Mere curious pleasure or ingenious pain."

Remember, Gentlemen, immediate usefulness alone is a fallacious recommendation for a branch of learning. Don't shun Pure Mathematics on the ground of its *purely speculative character*. "That sound judgment," says Professor De Morgan in his remarkable introduction to the London Edition of Ram Chandra's Maxima and Minima—"that sound judgment which gives men well to know what is best for them as well as that faculty of *invention* which leads to development of resources and to the increase of wealth and comfort, are both materially advanced, perhaps cannot rapidly be advanced, without a great taste for *pure speculation* among the general mass of the people, down to the lowest of those who can read and write ...." After giving a most satisfactory proof of the above statement the above-mentioned writer puts the conclusion in the following words :—

"The History of England as well as of other countries has impressed me with a strong conviction that pure speculation is a powerful instrument in the progress of a nation." Plato advised the Athenians to betake themselves to the study of Mathematics, in order to evade the pestilence incident to the international war which was raging in Greece

Mathematics is knowledge and consequently it is power. It is a *weapon*, though a very heavy one. If we cannot wield that weapon, the fault is all our own; because we *could* wield it if we *would*, by dint of patience and perseverance : and once wielded, that weapon is something awful in our hands, Knowledge of Mathematics is like an estate which should be watered and cultivated laboriously before it yields abundant crops. Many men have reaped rich harvests out of this apparently barren land.

The *processes* of the *Differentia* Calculus seem far remote from the Propositions of Physical Science. yet Newton was led by their aid to found a system of Mechanics equally suited to determine the motion of the stone falling to the ground, or the revolutions of the Planetary bodies. *Conics* is a branch of pure Mathematics dealing with the sections of a cone, It could hardly be

imagined as susceptible of any useful or interesting application whatever. But *Kepler* came and he applied it to the motions of heavenly bodies, thus clearing up most intricate difficulties in Astronomy. Moreover the same Conic Sections was found to apply to the motion of anything whatever projected here on our own planet; be it a cricket ball, an arrow or a bullet, or even our own bodies in the act of jumping. The process of finding the H. C. F of any two numbers in Algebra has been made use of by Sturm in solving with great ease Equations of any degree whatever. The *Theory of Quadratic Equations* was made use of by our own countryman, Master Ram Chandra of Delhi, in working out problems of great practical interest in Maxima and Minima. In Trigonometry and Algebra we meet with what are called *Exponential Functions* and *Imaginary* or *Impossible Quantities*. When you first study them, I suppose you will be inclined to say "Of what use in the real world are *Imaginary* quantities. why should we waste our time on *Impossibilities*?" My friends, let me inform you that what you will thus cast off with disdain, has lately been made the corner stone of a new mansion in the world of Science, being developed into Hyperbolic Functions The symbols e and π, (meaningless to the unthinking student,) repre-

sent numbers which enter into *analysis* from whatever side Science and Art are approached. An anecdote might be quoted for illustration De Morgan was explaining to an actuary what was the chance that at the end of a given time a certain proportion of some group of people would be alive; and quoted the actuarial formula involving π, which he explained stood for the ratio of the circumference of a circle to its diameter His acquaintance, who had so far listened with interest, interrupted him and exclaimed, 'My dear friend, that must be a delusion; what can a circle have to do with the number of people alive at the end of a given time?" Don't be surprised to know that Ball writes of a distinguished Professor remarking that "it is impossible to conceive of a universe in which e and π should dot exist."

I sympathise with those of you to whom the abstract principles involved in Mathematics appear to have scarcely any use or aim; but if you continue your inquiries, your matured judgment will *rectify* your first opinion and at length you will find yourselves possessed of, to use the words of Professor Hall, "an instrument of matchless power and of universal application; a language which nature must hear, and to which she shall always reply."

Even if the study of Mathematics bear no fruit at all, do not regard your labour spent on it as wasted Nothing is wasted or lost in nature, matter is indestructible and cannot be lost, energy is indestructible and cannot be lost; and so I maintain labour is indestructible and cannot be lost. Rivers take away with them a great deal of earth and other substances from the plains, and so far as we can see the earth carried away is lost, but the same earth collects in the sea, and in course of time forms islands there. The Sun dries up in the summer tanks, pools and lakes, and we think the water is lost; but before autumn is ushered in, the same water comes down again in the form of rains. Similarly kinetic energy is converted into potential energy, thermal energy, electric or any other form of energy, but it is never lost, although it may so appear to us. Just in the same way, rest assured, labour is never lost; it is sometimes changed into experience, at other times it becomes, as it were, stored up for future use; but it is never lost. The labour of Columbus, although it did not bring forth the desired result, was far from being lost; the attempts of Englishmen at finding the North-West passage to India although apparently fruitless, caused the Arctic Ocean to be explored. Similarly attempts at finding the philosopher's stone led to the discovery of the

Science of Chemistry. Again attempts at unreal Astrology led to real Astronomy. So, the apparently bootless endeavours of geometricians at the duplication of a cube, the trisection of an angle, and the squaring of a circle, were the cause of Conic Sections being discovered. The vain struggles and efforts to construct a perpetual-motion machine advanced most considerably the Science of Dynamics. The celebrated John Hunter occupied a great deal of his time in studying most carefully the growth of a deer's horn (a sheer waste of time and energy in the opinion of most of us); but this apparently useless knowledge well applied in the case of a dying patient was one of the causes which rendered his name immortal. His labour was not lost and so will not your labour be lost which you devote to the study of Mathematics, but will reproduce itself in other forms of fruitful energy. It is rather sacrilegious to think of lost labour in connection with a subject of which in the words of no less an authority than Helmholtz we may say, "Of all branches of human knowledge, there is none which, like it, has sprung as a completely armed Minerva from the head of Jupiter; none before whose death-dealing Aegis doubt and inconsistency have so little dared to raise their eyes."

The vibrations of a lamp suspended from the ceiling taught Galileo how to construct the first pendulum-clock; a falling apple gave Newton a lesson on the mysteries of the solar system; a boiling kettle instructed George Stephenson how to make the steam engine; a frog's leg twitching when placed in contact with different metals directed Galvani to come to the important results wherein lay the germ of the Electric Telegraph. If apparently insignificant objects could teach such important lessons, will not Mathematics (which means *Knowledge* and *Science* itself) be able to teach you a great deal?

Only a third eye is wanted (an eye in the head or brain, Mahadev's third eye) to discover the *Parvati* of joy and glory on the mountains of Mathematics. Oh! for the keen penetrating eye to which—

> "There are tongues in trees, books in the running brooks,
> Sermons in stones and good in everything."

We are reaping abundantly the fruits of the labours of others. We travel by rail, the most desirable kind of conveyance; we get our errands run by electricity harnessed for our sake, we live in comfortable houses, wear the clothes cut and sewn to suit our convenience, get our food cooked and prepared in such a way as to keep

us in good health and many other things we enjoy which have been thought out and worked out for us by others. Let us not forget that we also ought to do something for others in return We owe a heavy debt to humanity. Let us try to leave the world better than we found it. Let us try to leave some foot-prints on the sands of time. Let us try to dive deep into the Ocean of Science and Mathematics and bring out, if possible, some pearls which may adorn the world.

Then work, work; work with all your heart, with all your might, remembering that work is worship and remembering also that work is life.—

> " We live in deeds, not days;
> in thoughts, not breaths;
> in feelings, not in figures
> on a dial.
> He lives most who thinks most,
> feels the noblest, acts the best."

Genuine work will be found to be its own reward. Work is the normal state of man.

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How To Excel

IN

MATHEMATICS.

There is no royal road to Mathematics. Mathematicians, like poets, cannot be made but they are born. *Still I have firm conviction* that the following guiding principles and cautions, if strictly observed, shall convert Mathematics from a cold, unsociable stranger with knit brows and frowning countenance into a warm-hearted, cheerful and loving friend.

1 (*a*) Never approach Mathematics just after taking heavy meals. Let the food be well digested, and then apply yourself to this subject. Otherwise you will find it a very dry and rather repulsive study and most uninteresting.

(*b*) In days of hard Mathematical work you ought to take light simple food that you can digest very easily; and be temperate. Don't take *ghee* in excess. High thinking and plain living should go side by side.

2 (*a*) Don't attack Mathematical problems or hard pieces of book-work when you are sleepy or when about to go to bed. You will in that state find them quite invincible and impregnable,

Not only will they offer passive resistance, but will then lay you flat down on your bed. Plainly speaking you will in two or three minutes, after taking a difficult problem in hand, fall fast asleep. But you may, with advantage, at such a time, revise that part of Mathematics which you are already thoroughly conversant with, or work easy sums and simple riders that require very little mental exertion.

(*b*) In order to excel in Mathematics you should always give to *sleep* what is its due We cannot have a clear brain if we do not have enough of sleep. It is said of a great Mathematician, Des Cartes, that on account of his delicate health, he was permitted to lie in bed till late in the mornings; this was a custom which he always followed, and when he visited Pascal in 1647 he told him that the only way to do good work in Mathematics and to preserve his health was never to allow any one to make him get up in the morning before he felt inclined to do so.

3 (*a*), If, however circumstances oblige you to study difficult portions of Mathematics or solve hard problems just after taking meals or just before retiring to bed, you ought to keep standing as you work, or be walking up and down while you

think. Otherwise your efficiency of labour will be very small, and laziness will get the upper hand of you.

(*b*) Never neglect to take bodily exercise. This is a neglect which proves ruinous to most students.

Irregular students waste the greater part of their time in idleness but overwork themselves just before the examination, taking no exercise and setting at nought the laws of health. Thus they succeed very easily in breaking their health though not in passing the examination. Then, is imputed to labour what is brought about in reality by laziness; the charge is laid at the door of hard work, whereas it was indolence that impaired their health. Remember it is not labour that kills a student, but it is laziness or neglect of exercise that does so. Workers are sadly wanted in India, but not lazy - workers.

4 When you begin a new book, it is advisable first, to go through the book-work of the whole, at the same time doing the easy sums which come out on the first or, at most at the second trial. After thus once passing through the book begin it anew, and omit no example. By adopting this system, you will save a great

deal of your time and labour and your work will be most efficient.

5 As far as possible try to do everything with your own, unaided efforts. Not only should you try to solve the examples by your own exertions, but try to do the book work also without the aid of the author. Try, as it were to rediscover everything. This will do you immense good. Read the heading in the case of each Article or the enunciation in the case of each Proposition and then shut your book, and try if you can give your own demonstration. Think over the subject for a time, if your exertions seem to be fruitless, read one or two sentences from the top in that Article or Proposition and then closing the book try to complete the proof; if even then your attempts avail nothing, read one or two sentences from the *bottom* of the same Article or Proposition, and do your best to supply the parts of the proof not seen by you. If, then also you fail, read a little more of the book and try to fill up the gap yourself. Thus a part at least of each Article or Proposition must by all means, be drawn out from your own brain, if you want to acquire a sound knowledge of Mathematics. You may, at first read very little by this method, but whatever is

not learnt in this way forms but a very poor part of education. By and by your power will increase and this process will no longer be slow. Your progress will, after trying this method for a time, be both rapid and thorough, and you will find yourself quick to perceive and slow to forget It is to such readers that the Roman proverb applies: "Beware of the man of few books."

"The great danger," says a Mathematician, "which all mathematical students have to guard against is that of learning off book-work without fully mastering the essential points of the methods Mathematics cannot be crammed To be able to write out book work faultlessly is not sufficient. The why and wherefore of each step must be fully grasped, and students must not rest content unless they fully understand in every case what is the property to be proved what known results are assumed, and what methods are to be applied Otherwise their memory will be unfairly taxed, the work will degenerate into mere drudgery, and all this will be of little avail if the book work so assiduously committed to memory should be set with some triffling alteration—a frequent artifice among examiners for finding out whether candidates *really* know their work.

The solution of easy problems and riders, which is also practically indispensable, also depends almost entirely on a thorough knowledge of fundamental principles and methods, and those who do not clearly realize this are too often apt to rush on to results in their answers in the examination, and to use the words "it is obvious" or "evident" to conceal their ignorance of the intermediate steps, which, however, deceives no one but the candidates themselves. On the other hand those who will take the trouble to realize fully the methods of the book-work and the framework of facts on which each Proposition is built up, will possess sufficiently powerful machinery to solve any reasonable problems that may be set.

All that will then be required is *readiness* in applying their knowledge, and this can only be brought about by frequent practice in working examples.

6. Don't disdain or pass over sums containing easy applications of the formulæ and never be satisfied with *knowing* merely the *way* how to work out a rider; work it out *actually* carry your theory into practice Never forget the precious maxim "The way to more light is the faithful *use* of what we have." By so doing you will acquire practice which alone makes us perfect

You know the greater part of your University Examination-papers will consist of such easy riders; and even those questions in which brain-work is most prominent. depend not a little for their full and ready solution on practical applications of the formulæ If you are already practised in that work, you will finish in a very short time the whole of the paper, except those portions which require thinking, and out of the total amount of time alloted having got a great deal at your disposal for thinking only, you will most probably succeed in your efforts in this direction too, and thus do the whole of the paper. As it is not enough for a man to know the theory of swimming but he ought to have practice in that art if he wants to swim across a river; so is *practice* necessary for you if you want to swim across the troublous sea of University Examinations. Simple riders and easy sums are a great recreation to the student of Mathematics

Most students when asked to work out a sum, sometimes after making a few feeble efforts but frequently before making any give up in despair ejaculating the words "It is very difficult, it will not come out" But the self—same students after the problem has been explained to them, cannot help uttering. "Oh, it was so easy!" I say, yes, it was so easy, but you could not *get it out* ;

because you did not *enter into it.* You got frightened by the very appearance of the excercise You had no courage, no strong will, no patience or no Mathematical virtue.

7 Frequently *revise* the portions which you have already read; otherwise your further progress will be very very slow, and you will find yourself no match for the examiners. "Every Methematical book that is worth anything," says Professor Chrystal, "must be read backwards and forwards Go on but often return to strengthen your faith. When you come on a hard or dreary passage pass it over; and come back to it after you have seen its importance or found the need for it further on."

8 In order to attain dexterity in analysis and calculation and become expert in giving ready solutions to problems it is desirable to acquire the habit of performing mathematical investigations *mentally* No other discipline is so effectual in strengthening the faculty of attention; it gives a facility of apprehension an accuracy and steadiness to the conceptions; and what is a still more valuable acquisition, it habituates the mind o arrangements in its reasonings and reflections To give an illustration of how much it improves the intellectual powers I may cite the case of Euler, who had

always accustomed himself to that exercise ; and having practised t with assiduity he is an instance to what an astonishing degree it may be acquired

"Two of Euler's Pupils had calculated a converging series as far as the seventeenth term, but fonnd on comparing, the written results, that they differed one unit at the fiftieth figure; they communicated this difference to their master, who went over the whole calculation by head, and his decision was found to be the true one. For the purpose of exercising his little grandson in the extraction of roots, he has been known to form to himself the table of the first six powers of all numbers from 1 to 100, and to have preserved it actually in his memory."

9. Mathematics requires of us a great deal of time and energy ; we should be continually working at it. But though it requires our body to be always in motion, ever working, and subject to the laws of Dynamics; it demands our mind to be always at rest, in equilibrium and in a state subject, as it were, to the laws of Statics. A man wanting to excel in Mathematics, should banish care and anxiety from his mind, think of nothing else but his work should have a serene and tranquil heart, should allow

nothing to disturb his peace and calm of mind. His labour will bear little fruit unless he is able to keep his mind in perfect solitude; which in most cases, will require his body also to be in loneliness.

> One lesson, Nature, let me learn of thee,
> One lesson which in every wind is blown,
> One lesson of two duties kept at one
> Though the loud world proclaim their enmity—
> *Of toil unsever'd from tranquillity!*
> Of labour, that in lasting fruit outgrows
> Far noisier schemes, accomplish'd in repose,
> Too great for haste, too high for rivalry!
> Yes, while on earth a thousand discords ring,
> Man's senseless uproar mingling with his toil,
> Still do thy quiet ministers move on,
> Their glorious tasks in silence perfecting;
> Still working, blaming still our vain turmoil ;
> Labourers that shall not fail, when man is gone.
>
> (*Matthew Arnold.*)

10. A student of Mathematics should always have a humble heart and a *docile* spirit.

Carefully store in every piece of knowledge, gather every bit of Mathematical truth, what, if you can make no immediate use of them and what, if no pleasing result seems likely to spring from them.

> ". . . . because right is right, to follow right
> Were wisdom in the scorn of consequence."

What a noble spirit of research was betrayed by the great Mathematician when he spoke of himself as having been all his life but "a child gathering pebbles on the sea-shore"——a similitude expressing not only his humility, but alluding likewise to "the spirit in which he had pursued his investigations, as having been that not of selection and system-building but of childlike alacrity in seizing upon whatever contributions of knowledge Nature threw at his feet."

These directions may be summed up in a single one: —Love the subject. (Love conquers all,) and try, by every means possible, to keep yourself fn a state in which you may be able to concentrate your mind and pay close and undivided attention to the subject. This is a faculty, which if we consider the testimony of Newton sufficient evidence, is the great constituent of inventive power It is that complete retirement of the mind within itself, during which the senses are locked up; that intense meditation on which no idea can intrude; that firm, straightforward progress of thought, deviating into no irregular sally; that perfect *yoga*, where the mind becomes one with the subject; which can alone place Mathematical subjects in a light sufficiently strong to illuminate them fully, and

preserve the perceptions of the mind's eye in the right order.

In the end I shall lay before you the secret of success in the study of Mathematics as well as in that of any other undertaking, It is seeking not our own aggrandisement, but the glory of God; it is like the Red Cross Knight to labour and struggle for the Faerie Queen Gloriana or the Glory of God. It is thus to make our whole life a continuous prayer by our acts It is to carry into practice the noble advice of Lord Shri Krishna—

> ". . . . . In thy thoughts
> Do all thou dost for Me! Renounce for Me!
> Sacrifice heart and mind and will to Me!
> Live in the faith of Me!"

Let me close with the following strictly true lines of Shakespeare:—

> " Heaven doth with us as we with torches do,
> Not light them for ourselves; for if our virtues
> Did not go forth of us, 'twere all alike
> As if we had them not. Spirits are not finely touch'd
> But to fine issues; nor Nature never lends
> The smallest scruple of her excellence,
> But like a thrifty goddess she determines
> Herself the glory of a creator,
> Both thanks and use."

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